

Listing of Claims:

Claims 1-149. (Previously Cancelled)

150. (Previously Presented) A method for the production of nickel metal particles, comprising the steps of:

a) generating an aerosol of droplets from a liquid wherein said liquid comprises a nickel metal precursor and a reducing agent and wherein said droplets have a droplet size distribution wherein at least about 80 weight percent of said droplets have a size of from about 1 μm to about 5 μm ;

b) moving said droplets in a carrier gas; and

c) heating said droplets to remove liquid therefrom and form nickel metal particles comprising at least about 50 weight percent nickel metal.

151. (Original) A method as recited in Claim 150, wherein said carrier gas comprises hydrogen.

152. (Original) A method as recited in Claim 150, wherein said carrier gas comprises at least about 2 volume percent hydrogen.

153. (Original) A method as recited in Claim 150, wherein said carrier gas comprises hydrogen and an inert gas selected from the group consisting of nitrogen, argon, helium and xenon.

154. (Original) A method as recited in Claim 150, wherein said heating step comprises carrying said droplets through a heating zone having a reaction temperature of not greater than about 1455°C.

155. (Original) A method as recited in Claim 150, wherein said heating step comprises carrying said droplets through a heating zone having a reaction temperature of at least about 1200°C.

156. (Original) A method as recited in Claim 150, wherein said heating step comprises carrying said droplets through a heating zone having a temperature of from

about 1200°C to about 1400°C.

157. (Original) A method as recited in Claim 150, wherein said heating step comprises carrying said droplets through a heating zone having a temperature of from about 1200°C to about 1400°C and wherein said carrier gas comprises at least about 2.5 volume percent hydrogen.

158. (Original) A method as recited in Claim 150, wherein said metal particles have a particle density of at least about 7.1 g/cc.

159. (Original) A method as recited in Claim 150, wherein said metal particles have a particle density of at least about 8.0 g/cc.

160. (Original) A method as recited in Claim 150, wherein said droplets have a size distribution such that not more than about 20 weight percent of the droplets in said aerosol are larger than about twice the weight average droplet size.

161. (Original) A method as recited in Claim 150, wherein said step of generating an aerosol comprises the step of removing a first portion of droplets from said aerosol, wherein said removed droplets have an aerodynamic diameter greater than a preselected maximum diameter.

162. (Original) A method as recited in Claim 150, further comprising the step of concentrating said aerosol by removing a second portion of said droplets from said aerosol, wherein said second portion of droplets have an aerodynamic diameter less than a preselected minimum diameter.

163. (Original) A method as recited in Claim 150, wherein said liquid is a solution comprising a nickel metal precursor selected from the group consisting of nickel nitrate, nickel hydroxide, nickel chloride, nickel sulfate and nickel oxalate.

164. (Original) A method as recited in Claim 150, wherein said liquid is a solution comprising nickel nitrate.

165. (Original) A method as recited in Claim 150, wherein said liquid is a solution comprising from about 5 to about 15 weight percent nickel in the form of nickel nitrate.

166. (Previously Cancelled)

167. (Original) A method as recited in Claim 150, wherein said liquid comprises nickel nitrate and hydrazine.

168. (Original) A method as recited in Claim 150, wherein said liquid further comprises a densification aid.

169. (Original) A method as recited in Claim 150, wherein said liquid further comprises urea.

170. (Original) A method as recited in Claim 150, wherein said liquid further comprises a precursor to at least one metal alloying element.

171. (Original) A method as recited in Claim 150, further comprising the step of coating an outer surface of said nickel metal particles.

172. (Original) A method as recited in Claim 150, wherein said nickel metal particles are composite particles comprising a non-metallic phase dispersed throughout said particles.

173. (Original) A method as recited in Claim 150, wherein said liquid further comprises a coating precursor and wherein said nickel metal particles are coated nickel metal particles.

174. (Previously Presented) A method for the production of metal composite particles, comprising the steps of:

- a) forming a liquid solution comprising multiple precursors, including at least a nickel metal precursor and a non-metallic phase precursor;
- b) generating an aerosol of droplets from said liquid solution;
- c) moving said droplets in a carrier gas;
- d) heating said droplets to remove liquid therefrom and form metal composite particles comprising a metal phase derived from said nickel metal precursor and a non-metallic phase derived from said non-metallic phase precursor.

175. (Previously Cancelled)

176. (Original) A method as recited in Claim 174, wherein said carrier gas comprises hydrogen.

177. (Original) A method as recited in Claim 174, wherein said heating step comprises passing said droplets through a heating zone having a reaction temperature of not greater than about 1455°C.

178. (Original) A method as recited in Claim 174, wherein said heating step comprises passing said droplets through a heating zone having a reaction temperature of at least about 1200°C.

179. (Original) A method as recited in Claim 174, wherein said heating step comprises passing said droplets through a heating zone having a reaction temperature of from about 1200°C to about 1400°C and wherein said carrier gas comprises at least about 2.5 volume percent hydrogen.

180. (Original) A method as recited in Claim 174, wherein said metal composite particles have a particle density of at least about 90 percent of the theoretical density for said composite particles.

181. (Original) A method as recited in Claim 174, wherein said aerosol droplets have an average droplet size of from about 1 μm to about 5 μm and wherein not more than about 20 weight percent of said droplets are larger than about twice said average droplet size.

182. (Original) A method as recited in Claim 174, wherein said step of generating an aerosol comprises the step of removing a first portion of droplets from said aerosol wherein said droplets in said removed first portion have an aerodynamic diameter greater than a preselected maximum diameter.

183. (Original) A method as recited in Claim 174, further comprising the step of concentrating said aerosol and removing a second portion of said droplets from said aerosol, wherein said droplets in said removed second portion have an aerodynamic diameter less than a preselected minimum diameter.

184. (Previously Presented) A method as recited in Claim 174, wherein said nickel metal precursor is selected from the group consisting of nickel nitrate, nickel hydroxide, nickel chloride, nickel sulfate and nickel oxalate.

185. (Original) A method as recited in Claim 174, wherein said metal precursor is nickel nitrate.

186. (Original) A method as recited in Claim 174, wherein said liquid comprises nickel nitrate and a reducing agent.

187. (Original) A method as recited in Claim 174, wherein said non-metallic phase precursor comprises a metal salt dissolved in said liquid solution.

188. (Original) A method as recited in Claim 174, wherein said non-metallic phase precursor comprises particles suspended in said liquid solution.

189. (Original) A method as recited in Claim 174, wherein said non-metallic phase is a metal oxide.

190. (Original) A method as recited in Claim 174, wherein said non-metallic phase is selected from the group consisting of titanates, zirconates, silicates, aluminates, tantalates and niobates.

191. (Original) A method as recited in Claim 174, wherein said metal composite particles comprise nickel metal and not greater than about 25 weight percent of a non-metallic phase selected from the group consisting of titanates, zirconates and niobates.

192. (Original) A method as recited in Claim 174, wherein said non-metallic phase is selected from the group consisting of barium titanate and neodymium titanate.

193. (Original) A method as recited in Claim 174, further comprising the step of coating an outer surface of said metal composite particles.

194. (Presently Amended) A method for the production of metal alloy particles, comprising the steps of:

- a) forming a liquid solution comprising a nickel metal precursor, and a second metal precursor and a densification aid;

- b) generating an aerosol of droplets from said liquid solution,
- c) moving said droplets in a carrier gas; and
- d) heating said droplets to a temperature of from about 1200°C to 1400°C to remove liquid therefrom and form metal alloy particles comprising nickel metal and a second metal.

195. (Original) A method as recited in Claim 194, wherein said carrier gas comprises hydrogen.

196. (Original) A method as recited in Claim 194, wherein said heating step comprises passing said droplets through a heating zone having a reaction temperature of not greater than about 1455°C.

197. (Previously Cancelled)

198. (Original) A method as recited in Claim 194, wherein said metal alloy particles have a particle density of at least about 90 percent of the theoretical density for said metal alloy particles.

199. (Original) A method as recited in Claim 194, wherein said aerosol droplets have an average droplet size of from about 1 μm to about 5 μm and wherein not more than about 20 weight percent of said droplets are larger than about twice said average droplet size.

200. (Previously Presented) A method as recited in Claim 194, further comprising the step of removing a first portion of droplets from said aerosol wherein said droplets in said removed first portion have an aerodynamic diameter greater than a preselected maximum diameter.

201. (Original) A method as recited in Claim 194, further comprising the step of removing a second portion of said droplets from said aerosol, wherein said droplets in said removed second portion have an aerodynamic diameter less than a preselected minimum diameter.

202. (Original) A method as recited in Claim 194, wherein said nickel metal precursor is selected from the group consisting of nickel nitrate, nickel hydroxide, nickel

chloride, nickel sulfate and nickel oxalate.

203. (Original) A method as recited in Claim 194, wherein said nickel metal precursor is nickel nitrate.

204. (Original) A method as recited in Claim 194, wherein said liquid comprises nickel nitrate and hydrazine.

205. (Presently Amended) A method as recited in Claim 194, wherein said ~~liquid further comprises a densification aid~~ comprises urea.

206. (Original) A method as recited in Claim 194, wherein said second metal is selected from the group consisting of palladium, gold, copper, tungsten, molybdenum, tin, platinum, iron and cobalt.

207. (Original) A method as recited in Claim 194, wherein said second metal is palladium.

208. (Original) A method as recited in Claim 194, wherein said metal alloy particles comprise nickel metal and from about 0.1 to 40 weight percent of said second metal.

209. (Original) A method as recited in Claim 194, wherein said metal alloy particles are homogeneously alloyed with substantially no phase segregation of said nickel metal and said second metal.

210. (Original) A method as recited in Claim 194, further comprising the step of coating an outer surface of said metal alloy particles.

211. (Original) A method for the production of coated nickel metal particles, comprising the steps of:

- a) forming a liquid solution comprising a nickel metal precursor;
- b) generating an aerosol of droplets from said liquid solution;
- c) moving said droplets in a carrier gas;
- d) heating said droplets to remove liquid therefrom and form metal particles comprising nickel metal; and

e) coating an outer surface of said nickel metal particles.

212. (Original) A method as recited in Claim 211, wherein said coating step comprises contacting said metal particles with a volatile coating precursor.

213. (Original) A method as recited in Claim 211, wherein said coating step comprises contacting said metal particles with a volatile coating precursor selected from the group consisting of metal chlorides, metal acetates and metal alkoxides.

214. (Original) A method as recited in Claim 211, wherein said carrier gas comprises hydrogen.

215. (Original) A method as recited in Claim 211, wherein said heating step comprises passing said droplets through a heating zone having a reaction temperature of not greater than about 1455°C.

216. (Original) A method as recited in Claim 211, wherein said heating step comprises passing said droplets through a heating zone having a reaction temperature of at least about 1200°C.

217. (Original) A method as recited in Claim 211, wherein said coated metal particles have a particle density of at least about 90 percent of the theoretical density for said metal particles.

218. (Original) A method as recited in Claim 211, wherein said aerosol droplets have an average size of from about 1 μm to about 5 μm and wherein not greater than about 20 weight percent of said droplets are larger than about twice said average droplet size.

219. (Original) A method as recited in Claim 211, wherein said step of generating an aerosol comprises the step of removing a first portion of droplets from said aerosol wherein said droplets in said removed first portion have an aerodynamic diameter greater than a preselected maximum diameter.

220. (Original) A method as recited in Claim 211, further comprising the step of removing a second portion of said droplets from said aerosol, wherein said droplets in said removed second portion have an aerodynamic diameter less than a preselected

minimum diameter.

221. (Original) A method as recited in Claim 211, wherein said nickel metal precursor is selected from the group consisting of nickel nitrate, nickel hydroxide, nickel chloride, nickel sulfate and nickel oxalate.

222. (Original) A method as recited in Claim 211, wherein said nickel metal precursor is nickel nitrate.

223. (Original) A method as recited in Claim 211, wherein said liquid comprises a nickel metal precursor comprising nickel nitrate and a reducing agent comprising hydrazine.

224. (Original) A method as recited in Claim 211, wherein said coating is a metal oxide.

225. (Original) A method as recited in Claim 211, wherein said coating has an average thickness of not greater than about 100 nanometers.

226. (Original) A method as recited in Claim 211, wherein said coating has an average thickness of not greater than about 50 nanometers.

227. (Original) A method as recited in Claim 211, wherein said coating comprises a metal oxide selected from the group consisting of SiO_2 , Al_2O_3 , ZrO_2 , B_2O_5 , TiO_2 , Cu_2O , CuO , V_2O_5 , and Bi_2O_3 .

Claims 228-230. (Previously Cancelled)

231. (Previously Presented) A method as recited in Claim 150, wherein said reducing agent is selected from the group consisting of hydrazine and borohydrides.

232. (Previously Presented) A method as recited in Claim 150, wherein said reducing agent comprises hydrazine.

233. (Previously Presented) A method as recited in Claim 150, wherein said liquid comprises from about 1 to about 15 weight percent of said reducing agent.